

AD-A182 814

BLAST INDUCED LIQUEFACTION INSTRUMENTATION(U) COLORADO  
STATE UNIV FORT COLLINS DEPT OF CIVIL ENGINEERING  
W A CHARLIE 29 JUN 87 AFOSR-TR-87-0904 AFOSR-84-0231

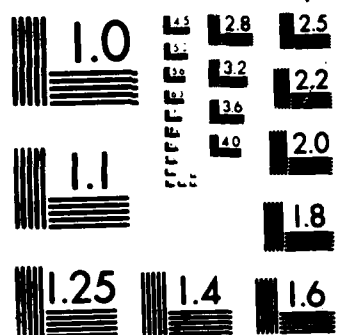
1/1

UNCLASSIFIED

F/G 14/2

NL

END  
8-87  
DTIC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
AD-A182 814			5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 87-0904		
6a. NAME OF PERFORMING ORGANIZATION Colorado State University		6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION AFOSR/NA		
6c. ADDRESS (City, State, and ZIP Code) Department of Civil Engineering Colorado State University Fort Collins, CO 80523			7b. ADDRESS (City, State, and ZIP Code) Building 410, Bolling AFB DC 20332-6448		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION AFOSR/NA		8b. OFFICE SYMBOL (If applicable) AFOSR/NA	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-84-0231		
8c. ADDRESS (City, State, and ZIP Code) Building 410, Bolling AFB DC 20332-6448			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO. 61102F	PROJECT NO. 2917	TASK NO. A1
11. TITLE (Include Security Classification) (U) Blast Induced Liquefaction Instrumentation					
12. PERSONAL AUTHOR(S) W A Charlie					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 7/25/84 TO 7/24/85		14. DATE OF REPORT (Year, Month, Day) 1987, June, 29	
				15. COUNT 6	
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	Blast, Explosive Induced Liquefaction, Shock Test, ←		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The instrumentation and equipment purchased under the "DOD-University Research Instrumentation Program" is currently being used to support AFOSR funded field research on Explosive Induced Liquefaction of Soils. The instrumentation is being used to provide high speed transient data acquisition of stress, water pressure, acceleration, data storage, data reduction, and test documentation to permit development of analytical, theoretical, and empirical models of the phenomena.</p> <p style="text-align: right;">(Key)</p>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Spencer T Wu			22b. TELEPHONE (Include Area Code) (202) 767-4935		22c. OFFICE SYMBOL AFOSR/NA

DTIC  
SELECTE  
JUL 30 1987  
C  
E

**AFOSR-TR- 87 - 0904**

FINAL REPORT

AFOSR-84-0231

JUNE 1987

DOD-University Research Instrumentation Program

BLAST INDUCED LIQUEFACTION  
INSTRUMENTATION

Dr. Wayne A. Charlie, P.E., Ph.D.  
Associate Professor of Civil Engineering

Department of Civil Engineering  
Colorado State University  
Fort Collins, CO 80523  
(303) 491-8584



Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

## I. INTRODUCTION

The research instrumentation purchased under the "DOD-University Research Instrumentation Program (Grant AFOSR-84-0231) is being used to support the instrumentation needs of current AFOSR funded research on Blast Induced Liquefaction of Water Saturated Soils (AFOSR-85-0172). The instrumentation is being utilized for the field phase of the AFOSR funded research and is needed to provide high speed transient data acquisition associated with explosive loadings, data storage and reduction, and test documentation.

## II. INSTRUMENTATION PURCHASED

The following major instrumentation and equipment was purchased:

<u>Instrumentation</u>	<u>Manufacturer</u>	<u>Cost</u>	<u>PO</u>
Slope Indicator	SINCO	\$5,352	45339
Piezoelectric Transducer and Adapter	SINCO	\$1,775	45339
Penetrometer	Hogentogler	\$10,000	45333
Video Camera	Panasonic	\$1,874	41946
Video Slow-Motion Playback	Panasonic	\$1,449	41946
Video Tripod and Case	Video Teknix	\$362	41947
Personal Computer System	IBM	\$12,562	41301
Transient Data Recorders	Pacific	\$43,941	41625
Computer Software	MacMillan	\$1,695	41218
Computer Plotter	Hewlett Packard	\$2,770	41213
Brinell Stress Gages	Applied Research	\$1,267	42037
Water Pressure Transducer and Indicator	SINCO	\$2,575	42201
Power Supply (UPS)	Solo	\$3,943	42282
Soil Stress Gages	Kulite	\$3,085	41602
Seismograph	GeoMetrics	\$5,880	41605
Oscilloscope	Nicolet	\$5,120	42009
Deair System Tank	Graingers	\$968	41953
Blast Monitor	SINCO	\$9,860	42316
Portable Micro Computer	Compaq	\$3,015	42011
Computer Memory Cards	AST	\$578	41458
Oxygen Monitor (Safety Equipment)	Medical	\$515	45444
HP-IB Computer Extender	Hewlett Packard	\$2,570	42035
Storage Shed	UBC	\$767	40690

Portable Drill Rig	Acker	\$5,130	45332
Multimeters	Fluke	\$628	41526
Vibrator Soil Compactor	Wacker	\$1,240	41603
Generator	Grainger	\$819	40689
Pressure Transducers	ENDEVCO	\$14,450	41759
Accelerometers	ENDEVCO	\$10,050	41760

Miscellaneous Items:

- Shipping and Insurance
- Augers
- Software
- Coaxial Cable and Connections

	\$945
<u>TOTAL</u>	<u>\$155,185</u>

### III. SUPPORTING AFOSR FUNDED RESEARCH

The instrumentation and equipment is located and used at the 1.5 acre explosive test site at Colorado State University. The site is surrounded by a 3 meter high berm and is located in a valley which is over 2 km from the nearest non-university structure. The test site was developed under AFOSR funding. All the instrumentation and equipment purchased under grant AFOSR-84-0231 is being utilized to support current AFOSR funded field research on the behavior of water saturated soils subjected to explosive loadings. The instrumentation is being used to provide high speed transient data acquisition of stress, water pressure, acceleration, data storage, data reduction and test documentation. The high speed video camera equipment is being used to document the tests. The computers are being used for data acquisition, reduction, modeling of the events, and for writing reports. The publication "Microcomputers in Shock Testing of Water Saturated Sands" by Charlie, Hassen and Doebling (The Shock and Vibration Bulletin, Bulletin 57, January 1987) gives details of the data acquisition system (both hardware and software) purchased under the grant.

Currently, four Ph.D. and nine M.S. graduate students are utilizing the instrumentation and equipment. Their research is aimed at gaining a better understanding of phenomena of blast induced liquefaction and to develop analytical, theoretical and empirical models of the phenomena.

### IV. SUMMARY

The instrumentation and equipment purchased under the "DOD-University Research Instrumentation Program" is currently being used to support AFOSR funded field research on Explosive Induced Liquefaction of Soils. The state-of-the-art instrumentation and equipment has greatly extended our



capabilities in measuring and understanding explosive induced dynamic events. Four Ph.D. and nine M.S. students are utilizing the instrumentation and equipment for their research. Several publications have been published on the results obtained by instrumentation and equipment obtained under this grant. Several other publications are being written. The tests have verified that liquefaction can be induced by explosive loadings.

END

8-87

DTIC